

MICRONEPHTHYS OCULIFERA (POLYCHAETA: NEPHTYIDAE), A REMARKABLE NEW SPECIES FROM HONG KONG, CHINA

Andrew S. Y. Mackie

ABSTRACT

A new species of *Micronephthys* is described from Hong Kong. It differs most noticeably from all other species in the genus, and from most other nephtyids, in possessing well-developed prostomial eyes. A detailed description is given and comparisons made with related species. The characteristics of the genus and the presence of eyes in the Nephtyidae in general are discussed.

The genus *Micronephthys* Friedrich, 1939 currently contains six species [*M. minuta* (Théel, 1879), *M. abbranchiata* (Ehlers, 1913), *M. ambrizettana* (Augener, 1918), *M. stammeri* (Augener, 1932), *M. sphaerocirrata* (Wesenberg-Lund, 1949) and *M. maryae* San Martin, 1982] and one subspecies [*M. sphaerocirrata orientalis* Lee and Jae, 1983]. Recently, Jirkov and Paraketsova (1996) have also referred *Aglaophamus neotenus* Noyes, 1980 to the genus. The generic allocation and synonymy of this, the proposed eighth member of the genus, has been subject to some debate (Noyes, 1980; Ohwada, 1985a; Hilbig, 1997; Lovell, 1997) and, together with the discovery of the new species from Hong Kong, helps re-focus attention on the, often misunderstood, characteristics of *Micronephthys*.

MATERIALS AND METHODS

All specimens of the new species were collected from shallow (<12 m) sandy sediments in the outer Tolo Channel and Mirs Bay areas (22°28'–22°34'N, 114°17'–114°27'E), northeastern New Territories, Hong Kong, during the 2nd and 4th International Marine Biological Workshops held respectively in April 1986 and 1989. Much of the material was collected by, or for, Professor Christer Erséus of the Swedish Museum of Natural History. The '1986-' prefixed station numbers given below refer to those in Erséus (1990), while the 'E-' prefixed ones relate to the Hoi Ha Wan oligochaete summary of Erséus (1992b). Maps showing the main sampling locations can be found in Gibson (1990: fig. 1; region encompassing areas 7–17) and Erséus (1992b: fig. 1). Many of the stations were similar to those previously studied by Erséus (1984: 136–138, fig. 1). Additional information on the annelid fauna recorded in 1989 was given in Erséus (1992a,b), Sundberg et al. (1992) and Mackie et al. (1993). The *Micronephthys* sp. listed in the last two publications approaches *M. sphaerocirrata* and will be considered elsewhere in a wider examination of the genus.

The worms were separated from diver-collected sediment samples by decantation into either a 0.25 or 0.5 mm mesh sieve and sorted live in the laboratory on the day of collection. Some animals were relaxed using menthol. All specimens were fixed in 10–15% formaldehyde (i.e., ≥25% formalin) in seawater and later washed in freshwater prior to preservation in 80% alcohol (Mackie and Oliver, 1996). The occurrence of any glandular tissue was investigated using methyl green staining as used by Mackie and Gobin (1993). The dissected jaw was placed in a cavity slide and the remaining attached pharyngeal tissue removed by the careful addition of bleach.

Width measurements, between notopodial tips, were made at about chaetiger 10–12. All drawings were prepared using either a Wild M8 zoom, or Nikon Labophot-2 compound, microscope; both with the aid of camera lucida attachments. Photographs of the anterior region were taken using a Wild M400 Photomakroskop in conjunction with a Wild MPS45 Photoautomat exposure control unit. Relationships between morphological attributes were determined using StatView ver. 4.5 (Aba-

cus Concepts Inc., Berkeley) on a Macintosh G3 computer; the graphs were finalized using Adobe Illustrator ver. 6.0.

Type material is deposited in the National Museum of Wales, Cardiff (NMW), Swedish Museum of Natural History, Stockholm (SMNH), the Swire Institute of Marine Science, University of Hong Kong (SWIMS) and the Natural History Museum, London (BMNH).

SYSTEMATICS

Family Nephtyidae Grube, 1850

Genus *Micronephthys* Friedrich, 1939

TYPE SPECIES.—*Nephtys minuta* Théel, 1879; designated by Friedrich (1939).

Micronephthys oculifera new species

(Figs. 1–4)

Material Examined.—Hong Kong: Hoi Ha Wan (Jones Cove), sta. 86–80 (E-9), southwest of Flynn Point, medium to coarse shell sand, 6 m, 1 paratype (NMW.Z.1986.079.154), coll. C. Erséus, 11.IV.86; Hoi Ha Wan, sta. 86–81 (E-10), north of Chuen Lo Kok Tsui (Tide Pole Point), small patches of coarse sand among corals, 2–3 m, 2 paratypes (NMW.Z.1986.079.155), coll. C. Erséus, 11.IV.86; same locality, fine to medium sand, 5 m, holotype (NMW.Z.1986.079.156) and 1 paratype (NMW.Z.1986.079.157), coll. C. Erséus, 17.IV.86; same locality, sta. E-20, medium shell sand with *Corophium*, 6 m, 1 paratype (NMW.Z.1989.117.038; menthol relaxed), coll. C. Erséus, 13.IV.89; same locality, sta. E-21, fine shell sand, 8 m, 2 paratypes (SMNH 5077), 2 paratypes (SMNH 5078; menthol relaxed), coll. C. Erséus, 13.IV.89; Hoi Ha Wan, sta. E-19, north of Sam Po Shek (Joss House Point), coarse shell sand 3.5 m, 2 paratypes (NMW.Z.1989.117.039-040; menthol relaxed), coll. C. Erséus, 12.IV.89; Hoi Ha Wan, west of Ngan Chau (Flat Island), sta. 86-99 (E-11), silty fine to medium sand between corals, 4 m, 3 paratypes (NMW.Z.1986.079.158-159), coll. C. Erséus, 17.IV.86; Hoi Ha Wan, east of Heung Lo Kok (Gruff Head), sta. 86-54 (E-8), muddy sand and shell, 3 m, 1 paratype (SWIMS-ANN-99-242), coll. C. Erséus, 5.IV.86; Chek Mun Hoi Hap (Tolo Channel), sta. 86–86, off east headland of Fung Wong Wat, bay northwest of Gruff Head, silty shell sand, 9 m, 4 paratypes (SWIMS-ANN-99-243), coll. A.S.Y. Mackie, 13.IV.86; northwest of Chek Chau (Port Island), Tai Chek Mun (North Channel entrance to Tolo Channel), sta. 86–79, silty medium to coarse sand, 8 m, 1 juvenile paratype (NMW.Z.1986.079.160), coll. C. Erséus, 16.IV.86; Wong Chuk Kok Tsui (Bluff Head), near northern entrance to Tolo Channel, silty fine to medium sand, 12 m, 4 paratypes (NMW.Z.1986.079.161), paratype (BMNH 2000.928), coll. C. Erséus, 16.IV.86; Yan Chau Tong (Double Haven), west of north end of Wong Wan Chau (Double Island), medium sand, 9 m, 1 paratype (NMW.Z.1986.079.162), coll. C. Erséus, 12.IV.86; east side of Wang Mun Hoi (Deep Pass), between Kat O Chau (Crooked Island) and Ngo Mei Chau (Crescent Island), sta. 86–60, heterogeneous shell sand and gravel with silt and organic matter, 7–8 m, 1 juvenile paratype (NMW.Z.1986.079.163), coll. C. Erséus, 7.IV.86; same locality, but further north near Tai Kok Tau (northwest point of Crescent Island), sta. 86–61, heterogeneous shell sand and gravel with silt and organic matter, 4 m, 3 paratypes (NMW.Z.1986.079.164-165), coll. C. Erséus, 7.IV.86; Kat O Chau, south of Kai Kung Tau (Peaked Head), sta. 86–51, poorly sorted shell sand, 6 m, 1 paratype (NMW.Z.1986.079.166), coll. C. Erséus,

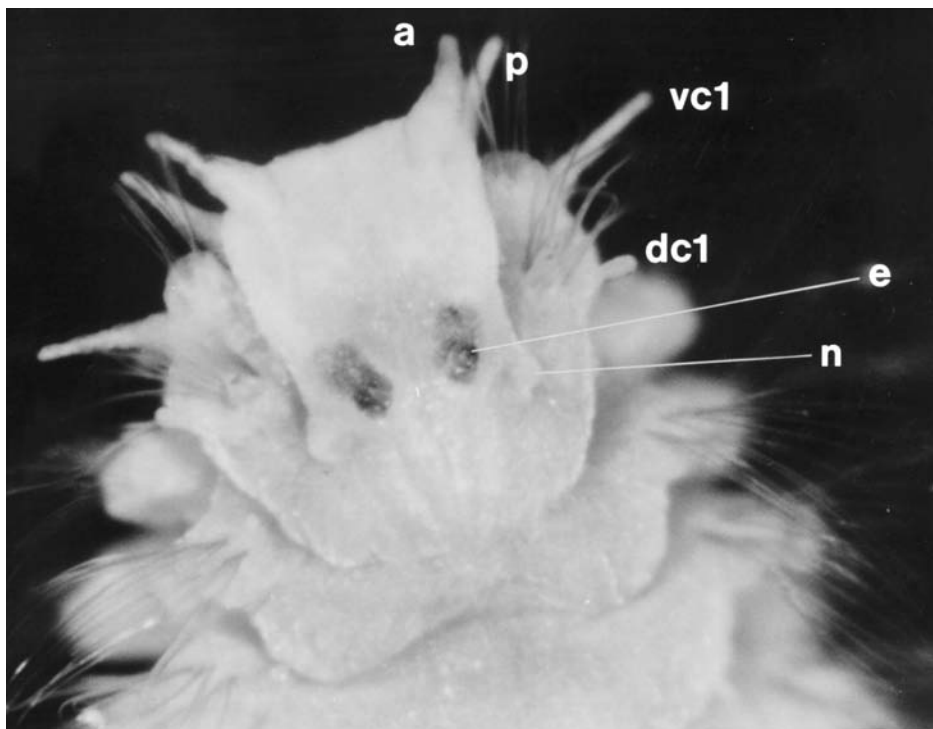


Figure 1. *Micronephthys oculifera* new species (NMW.Z.1989.117.040). Anterior region, dorsal view (a, antenna; p, palp; e, eye; n, nuchal organ; dc1, dorsal cirrus of chaetiger 1; vc1, ventral cirrus of chaetiger 1). Prostomial width (max.), 350 μ m; width (max.) across first chaetiger, 575 μ m.

5.IV.86; Kai Kung Pai (Cock's Head Rock), east of Peaked Head, silty coarse shell sand, 8 m, 3 paratypes (NMW.Z.1989.117.041), coll. B. Darvell, 18.IV.89; Tai Pang Wan (Mirs Bay), southeast corner of Ping Chau, silt, 9 m, 2 paratypes (NMW.Z.1986.079.167), coll. C. Erséus, 15.IV.86; same locality, silty shell sand between corals, 8 m, 1 paratype (NMW.Z.1989.117.042), coll. A.S.Y. Mackie, 15.IV.89.

Description.— Holotype, largest of 38 types, 1.35 mm wide and 19.0 mm long in two fragments totaling 59 chaetigers, posterior two of which possibly regenerated. Photographed paratype (NMW.Z.1989.117.040) widest, 1.40 mm, 14.0 mm long for 49 chaetigers (posteriorly incomplete) with very large somewhat coalesced eyes. Maximum number of chaetigers 62 for entire paratype (NMW.Z.1986.079.155), 1.13 mm wide and 15.0 mm long. Two juveniles (NMW.Z.1986.079.163 and 160), 0.35 and 0.50 mm wide, 1.1 and 3.0 mm long, entire with 16 and 28 chaetigers, respectively.

Prostomium subtrapezoidal, anterior margin slightly broader than maximum posterior width (Figs. 1,2A), with posterior medial triangular prolongation (not always obvious) bisecting dorsum of chaetiger 1. Lateral antennae widely separate on anterior margin; palps arise immediately ventrolateral to antennae at anterolateral margins. Antennae and palps of similar shape and size: long, slender conically tapered with slightly swollen tips. Two pairs of conspicuous brown eyes occur in close (abutting or slightly overlapping) trapezoid arrangement on posterior prostomium, anterior pair set wider apart and slightly more subdermal than posterior pair. Nuchal organs at posterolateral prostomial margins,

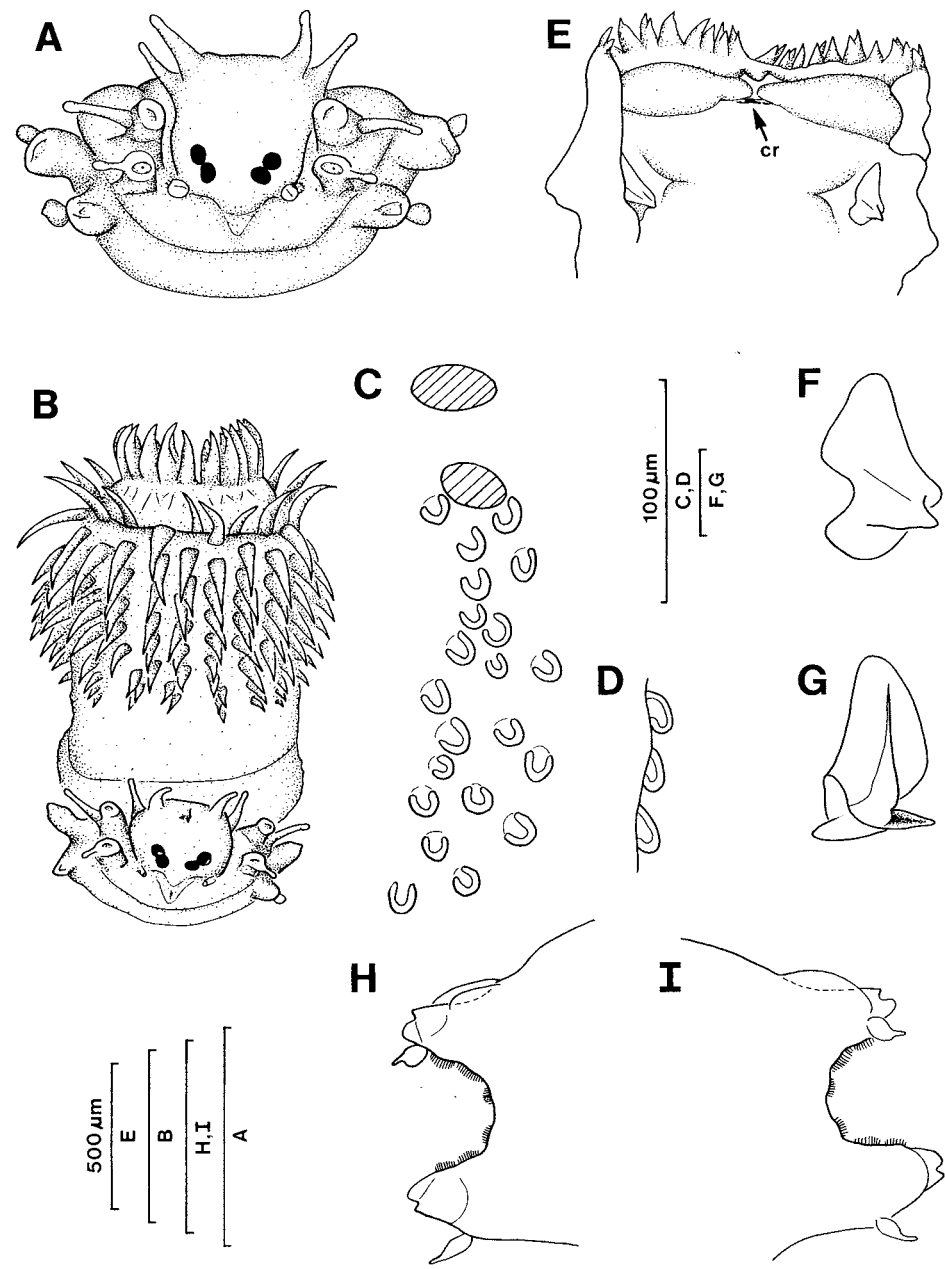


Figure 2. *Micronephthys oculifera* new species (A, H, I: holotype, NMW.Z.1986.079.156; B-D: NMW.Z.1989.117.038; E-G: NMW.Z.1986.079.154). A. Anterior region, dorsal view (chaetae omitted); B. Anterior region with pharynx everted, dorsal view (chaetae omitted); C. Last two pharyngeal row papillae (in cross-section) and following band of verrucae, dorsal view; D. Pharyngeal verrucae, lateral view; E. Pharynx cut mid-dorsally and opened out, dorsal view (cr = chitinized ridge); F. Right jaw, dorsal view; G. Right jaw, ventral view; H. Chaetiger 21, anterior view (chaetae omitted); I. Chaetiger 21, posterior view (chaetae omitted).

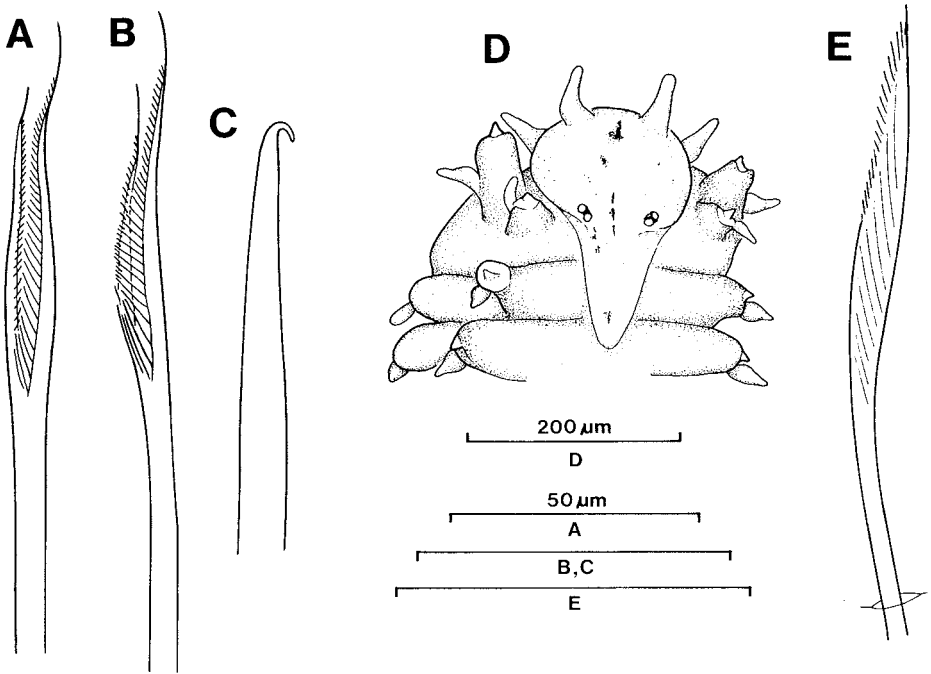


Figure 3. *Micronephthys oculifera* new species (A, B: holotype, NMW.Z.1986.079.156; C: NMW.Z.1986.079.155; D: NMW.Z.1986.079.163; E: NMW.Z.1986.079.160). A. Lyriform chaeta from chaetiger 45, slightly oblique view of distal region; B. Lyriform chaeta from chaetiger 23, oblique lateral view of distal region; C. Acicula, distal region; D. Anterior region of juvenile, dorsal view (chaetae omitted); E. Short blade-like spinulose chaeta, median chaetiger of juvenile.

behind and lateral to eyes. Each nuchal organ small, round and papilliform (Figs. 1,2A); projecting dorsally as short cylindrical tubes when everted (Fig. 2B). Posterior margins of prostomium weakly delineated, more clearly discerned using methyl green stain. Brain posteriorly bilobed, lying just below prostomium, extending back through chaetiger 2.

Pharynx almost completely everted (Fig. 2B) in six paratypes. Distal opening with continuous ring of 20 bifurcate terminal papillae; each bifurcation sharply conical, outer ones longer and more slender than inner ones. Subdistally, external surface with 22, evenly spaced and almost regularly staggered, longitudinal rows of 6–10 (most often 8–9 or 9–10) papillae on largest four paratypes (1.10–1.20 mm wide). Another smaller paratype (0.85 mm wide) with 4–8 (mostly 7) papillae per row, while smallest (0.50 mm wide) of the six with least papillae (up to 5 or 6) per row. Subdistal papillae long, conically tapered with slender tips, and posteriorly directed. In each row, papillae decrease in size posteriorly, but always conspicuous; however, first (distalmost) papillae on alternate staggered rows shorter and more slender than either those immediately following or first papillae of neighboring rows. Sometimes longitudinal lines of posteriormost (i.e., smallest) 3–4 papillae may be positioned somewhat intermediate between two rows and difficult to assign to one particular row. No mediodorsal subdistal papilla. Proximal half of pharynx with numerous minute (10–17 μm diameter), thick-walled and posteriorly directed, verrucae; arranged in longitudinal bands as irregular continuations of papillary rows (Fig. 2C,D).

Immediately inside circular oral orifice, single small obtusely triangular papillae project inwards in mid-dorsal and mid-ventral position (Fig. 2E). Thereafter pharyngeal muscu-

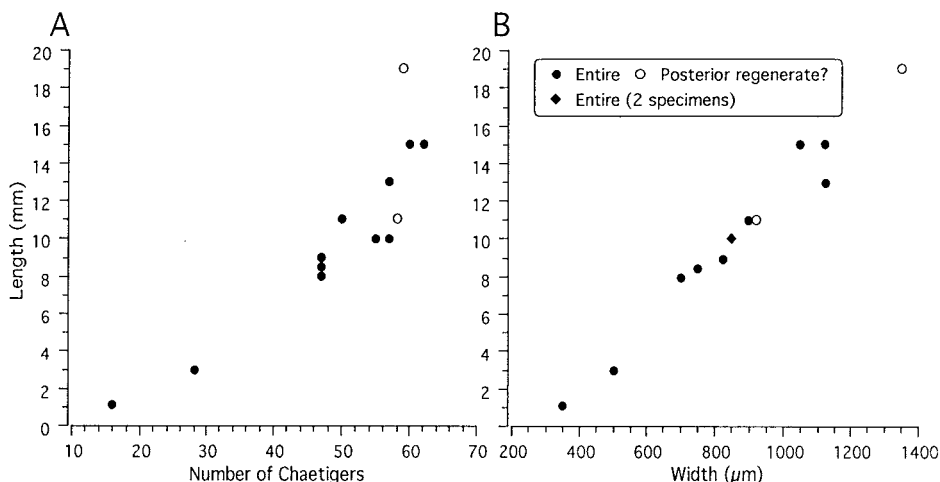


Figure 4. Size related morphological variability in *Micronephthys oculifera* new species. A. Length relative to number of chaetigers; B. Length relative to width. Largest posteriorly regenerated specimen is the holotype.

lature rapidly narrows opening to vertical slit; immediately after which occurs a short narrow anteroventral ridge which, in a few specimens (e.g., NMW.Z.1986.079.154 and 158), exhibits light to moderate chitinization. Further back and laterally situated, one pair of true jaws project inwards. Jaws brown, chitinous; asymmetrically conical, with sharp curved tips (Fig. 2F); each supported by internal longitudinal ridge (Fig. 2G).

First chaetiger well-developed, of similar size to those following. Neuropodia conspicuous cylindrical processes, projecting forwards anteroventral to notopodia. Ventral cirri long, slender and tapered, with slightly swollen tips; very like antennae and palps in size and shape. Notopodia also cylindrical, but shorter and less prominent, up to half length of neuropodia. Dorsal cirri about half length and less tapered than ventral cirri, with conspicuously swollen tips.

Parapodia from chaetiger 2 onwards with smaller dorsal and ventral cirri (Fig. 2H,I); latter generally more slender and slightly longer than former. Each cirrus somewhat bulbous with basal constriction and digitiform terminal process, arising from posteroventral surface of respective rami; dorsal cirri more distally positioned. Both parapodial rami with sharply pointed conical acicular lobes. Prechaetal lamellae barely perceptible, ridge-like, except short superior part of notopodial and inferiormost part of neuropodial ones projecting; latter less obvious. Postchaetal lamellae more developed; long superior part of notopodial ones clearly projecting, neuropodial ones only slightly so throughout. Each notopodium with bluntly rounded subacicular process; each neuropodium with similar supraacicular process. Interramal regions with six tufts of cilia; medial two tufts smaller and more separate than others, which can be more or less confluent. Interramal cirri (branchiae) completely lacking.

Aciculae pale yellowish, one per ramus, with smooth curved tips (Fig. 3C). Preacicular chaetae all straight barred capillaries (6–8 per ramus) throughout, except barred capillaries completely lacking in neuropodia of first chaetiger (only long smooth capillaries present). Barred capillaries of first notopodia same as on following chaetigers, not modi-

fied. Postacicular and medial chaetae comprise longer, finely spinulose and curved, capillaries (20–40) and, from about chaetiger 3 or 4, lyriform chaetae (1–5, sometimes absent). Lyriform chaetae with unequal tines; both tines with long spines along inner margins (Fig. 3A). Spines of each tine project out towards each other on one side of chaeta (Fig. 3B). On holotype, number of barred chaetae per ramus fairly constant throughout, with spinulose and lyriform chaetae most numerous in median body region (between about chaetigers 12 and 50).

Pygidium with slightly oblique, but terminal, anus; ventrally with single long (about 3 mm for a 15 mm long specimen) smooth filiform cirrus.

Reproduction.—Both males and females present. Most specimens of width greater than 0.70–0.75 mm reproductive; 48% female, 42% male and 10% not determined. Ova, located in parapodia, up to 100 μ m diameter (50–100 μ m). The presence of two juveniles indicated that reproduction commenced sometime prior to April.

Juveniles.—Prostomium as in adults except both pairs of eyes small (each eye about 8 μ m diameter) and close together giving appearance (at $\times 40$ magnification) of single pair only, and posterior prolongation more obvious; in the smaller juvenile encroaching into chaetigers 2 and 3 (Fig. 3D). Ventral cirri in both juveniles as in adults but dorsal cirri not quite so bulbous, being comparatively narrower, more conical and sharply tapering. Only one lyriform chaeta (notopodial) seen on larger juvenile; none on smaller. Juveniles with several short, blade-like, spinulose chaetae per parapodium (Fig. 3E) in addition to the barred capillaries and long spinulose chaetae found in adults. Anal cirrus of larger juvenile with well-spaced, more or less bilaterally arranged, cylindrical papillae; these very short basally, but long (about 25 μ m, equal to cirrus width) and slender (about 5 μ m wide) near cirrus tip.

Color.—Alcohol preserved adult specimens uniformly white to yellow, straw colored; with conspicuous, reddish- to dark-brown, prostomial eyes. Prostomium of smaller juvenile with black pigmentation in slender median line between the eyes, in an approximate medial spot and in a larger, more diffuse, subdermal patch near anterior prostomial margin; some other indistinct light brown coloring also irregularly distributed on prostomium and pygidium. Adult prostomia often unpigmented, but sometimes exhibiting some black subdermal pigmentation anteriorly and/or in fine medial line on posterior prolongation.

Methyl Green Staining.—Staining was fairly uniform and weak, apart from being slightly stronger in three narrow parallel lines along the medioventral groove, in a fine mediodorsal line (= dorsal blood vessel) on the anterior 9–12 chaetigers (and discontinuously on later chaetigers), in two dorsolateral lines running just above notopodial bases and on posterior half of prostomium from just anterior to eyes. The strongest and most persistent staining occurred with the intrapapodial sperm masses of ripe males.

Allometry.—Number of chaetigers, width and length show clear size-related interrelationships for the 11 entire specimens showing no evidence of posterior regeneration. Bivariate plots of these attributes (Figs. 4A,B) include, for comparison only, two additional specimens (including holotype) each of which may possibly have regenerated the posterior two or three chaetigers. Seven additional entire specimens exhibited clear signs of more extensive regeneration and were not included. For the non-regenerated entire specimens, the relationships between the morphological variables were strong and best described as follows:

$$\begin{aligned}\ln[\text{Length(mm)}] &= 1.913 \ln[\text{Chaetigers}] - 5.228; & r^2 &= 0.983 \\ \text{Length(mm)} &= 0.018 [\text{Width(}\mu\text{m)}] - 5.100 & r^2 &= 0.963 \\ \text{Chaetigers} &= 38.681 \ln[\text{Width(}\mu\text{m)}] - 209.799 & r^2 &= 0.942\end{aligned}$$

Etymology.—The specific name, meaning bearing eyes, is derived from the Latin; *oculus* (eye) together with suffix *-fera* (from *fero*; to bear, bring, carry).

Habitat.—The new species is only known from predominantly sandy sediments in shallow (2–12 m) waters of the northeastern New Territories, Hong Kong, China.

Remarks.—The presence of prostomial eyes readily distinguishes the new species from all other described species of *Micronephthys*. Eyes in other species, when reported, are situated subdermally on the brain at the level of chaetiger 2 or 3. The chitinization of the short anteroventral ridge within the anterior pharynx of some specimens is unusual and may possibly aid prey capture. However, the chitinization was weak compared to that exhibited by the lateral jaws.

DISCUSSION

The new species differs from all other members of the genus, and from most other nephtyids, in possessing prostomial eyes. A few nephtyids (e.g., *Nephtys brevibranchis* Hartmann-Schröder, 1959; *N. sukumoensis* Kitamori, 1960; *Aglaphomus victoriae* Rainer and Kaly, 1988; *Inermonephthys tetrophthalmos* Rainer and Kaly, 1988) have been depicted with such eyes but, in each case relative to prostomial size, they were very small and not so developed as in the new Hong Kong *Micronephthys*. When present, pigmented eyes are generally located on the posterior brain (Clark, 1956) and are only visible through the dorsal cuticle of an anterior chaetiger (e.g., chaetiger 2 or 3) in small nephtyid species or in juveniles of large ones.

Clark (1956) described the pigmented eyes as being comprised of a pair of single-celled receptors embedded either side on the posterior brain. He also recognized two pairs of unpigmented photoreceptor cells in the anterior prostomium of many species of *Nephtys*. From experiments with various species, Clark considered the eyes to be completely functional only in small species where they lay close to the dorsal surface. The posterior eyes were regarded as homologous with the posterior pair of *Nereis*, though the homology (and functionality) of the anterior eyes was less certain.

Most species of *Micronephthys* have been described as having a single pair of subdermal eyes on chaetiger 2 (e.g., *M. sphaerocirrata orientalis*), 3 (e.g., *M. stammeri* as re-described by Banse 1959) or 4 (e.g., *M. minuta* as figured by Jirkov and Paraketsova, 1996). Interestingly, *M. maryae* was figured (San Martin, 1982; Rainer and Kaly, 1988) with two pairs of subdermal eyes at chaetiger 3, although the latter description only mentions a single pair. In *M. oculifera* n. sp., there are two pairs in an arrangement reminiscent of that in nereidids. Clark (1956) described the posterior photoreceptor cells as each being about $40 \times 20 \mu\text{m}$ in larger nephtyids such as *Nephtys californiensis* Hartman, 1938 and *N. caeca* Fabricius, 1780, and about half that in the smallest species studied (*N. cornuta* Berkeley and Berkeley, 1945: 13–15 mm long). The eyes of *M. oculifera* at up to 45–65 μm diameter for the largest specimens (15–19 mm long) are therefore reasonably consistent with this assessment, assuming they too are composed of paired photoreceptor cells. Detailed histological examination is required before the structure and homology of the eyes in the new species can be determined.

Micronephtys is rather ill-defined, with the main features being 'reduction or loss of parts' (Hartman, 1950). Fauchald (1977) focused on 'rudimentary or absent' interramal cirri in his nephtyid key while, for some (e.g., Pettibone, 1963; Taylor, 1984), rudimentary or absent parapodial lamellae were the main characteristic. Fauchald (1968), Noyes (1980) and Ohwada (1985a, b) erroneously stated that the genus lacked interramal cirri.

Only two species, the type *M. minuta* and the recently referred *M. neotena*, have some interramal cirri. The remainder, completely lacking interramal cirri, do appear to share several other characteristics in common (e.g., shape of dorsal and ventral cirri, lack of mediodorsal subdistal pharyngeal papilla) and may form a distinct group. However, as many of the described species are poorly known, no definite reappraisal of the status of *Micronephtys* is possible at present. Work is in progress to redescribe other species attributed to the genus. Only then can the relationship of all the species with other nephtyids and the status of the genus itself be properly evaluated.

ACKNOWLEDGMENTS

I would like to thank B. Morton for inviting me to the 2nd and 4th International Marine Biological Workshops, during which material for this study was collected. C. Erséus kindly shared his samples, allowing me to extract the polychaetes, and G. Oliver, R. Gibson and many other workshop participants helped with the collecting. Color photography for the polychaete conference poster benefited greatly from the assistance of J. Carter, and J. Wild prepared black and white prints for publication, while C. Meechan prepared the final graphs. I gratefully acknowledge the National Museum of Wales for funding both Hong Kong visits and my attendance at the 6th International Polychaete Conference in Brazil.

LITERATURE CITED

- Augener, H. 1918. Polychaeta. Beitr. Kennt. Meeresfauna Westafri. 2: 67–625, pl. II–VII.
- _____. 1932. Die Polychaeten und Hirudineen des Timavogebietes in der Adriatischen Karstregion. Zool. Jb. (Abt. Syst. Ökol. Geogr. Tiere) 63: 657–680.
- Banse, K. 1959. Polychaeten aus Rovinj (Adria). Zool. Anz. 162: 295–313.
- Berkeley, E. and C. Berkeley. 1945. Notes from the coast of western Canada. III. Further notes on Syllidae and some observations on other Polychaeta errantia. Ann. Mag. Nat. Hist., ser. 11. 12: 316–335.
- Clark, R. B. 1956. The eyes and the photonegative behaviour of *Nephtys* (Annelida, Polychaeta). J. Exp. Biol. 33: 461–477.
- Ehlers, E. 1913. Die Polychaeten-Sammlungen der deutschen Südpolar-Expedition 1901–1903. Dt. Südpol.-Exp. 13: 397–598.
- Erséus, C. 1984. The marine Tubificidae (Oligochaeta) of Hong Kong and southern China. Asian Mar. Biol. 1: 135–175.
- _____. 1990. Marine Oligochaeta of Hong Kong. Pages 259–335 in B. Morton, ed. Proc. 2nd Int'l. Mar. Biol. Workshop: The marine flora and fauna of Hong Kong and southern China, Hong Kong, 2–24 April 1986. Hong Kong Univ. Press, Hong Kong. 1268 p.
- _____. 1992a. Hong Kong's marine Oligochaeta: a supplement. Pages 157–180 in B. Morton, ed. Proc. 4th Int'l. Mar. Biol. Workshop: The marine flora and fauna of Hong Kong and southern China, Hong Kong, 11–29 April 1989. Hong Kong Univ. Press, Hong Kong. 921 p.
- _____. 1992b. Oligochaeta from Hoi Ha Wan. Pages 909–917 in B. Morton, ed. Proc. 4th Int'l. Mar. Biol. Workshop: The marine flora and fauna of Hong Kong and southern China, Hong Kong, 11–29 April 1989. Hong Kong Univ. Press, Hong Kong. 921 p.

- Fabricius, O. 1780. Fauna Groenlandica, systematice sistens, Animalia Groenlandiae occidentalis hactenus indagata, quod nomen specificum, triviale, vernaculumque; synonyma auctorum plurium, descriptionem, locum, victum, generationem, mores, usum, capturamque singuli; prout detegendi occasio fuit, maximaque parti secundum proprias observationes. Hafniae and Lipsiae. 452 p.
- Fauchald, K. 1968. Nephtyidae (Polychaeta) from the Bay of Nha Trang, South Viet Nam. *Naga Rep.* 4(3): 5–33.
- _____. 1977. The polychaete worms. Definitions and keys to the orders, families and genera. *Sci. Ser. Nat. Hist. Mus. Los Angeles County* 28: 1–188.
- Friedrich, H. 1939. Polychaeten-Studien. IV. Zur Polychaetenfauna der Barents-See. *Kieler Meeresforsch.* 3: 122–132.
- Gibson, R. 1990. The macrobenthic nemertean fauna of Hong Kong. Pages 33–212 in B. Morton, ed. *Proc. 2nd Int'l. Mar. Biol. Workshop: The marine flora and fauna of Hong Kong and southern China, Hong Kong, 2–24 April 1986*. Hong Kong Univ. Press, Hong Kong. 1268 p.
- Grube, A. E. 1850. Die Familien der Anneliden. *Arch. Naturgesch.* 16: 249–364.
- Hartman, O. 1938. Review of the annelid worms of the family Nephtyidae from the Northeast Pacific, with descriptions of five new species. *Proc. U.S. Nat'l. Mus.* 85: 143–158.
- _____. 1950. Goniadidae, Glyceridae and Nephtyidae. *Allan Hancock Pacif. Exped.* 15: 1–181.
- Hartmann-Schröder, G. 1959. Zur Ökologie der Polychaeten des Mangrove-Estero-Gebietes von El Salvador. *Beitr. Neotrop. Fauna* 1: 69–183.
- Hilbig, B. 1997. Family Nephtyidae Grube, 1850. Pages 317–349 in J. A. Blake, B. Hilbig and P. H. Scott, eds. *Taxonomic atlas of the benthic fauna of the Santa Maria Basin and the western Santa Barbara Channel. 4. The Annelida. Part 1 Oligochaeta and Polychaeta: Phyllodocida (Phyllodocidae to Paralacydoniidae)*. Rev. ed. Santa Barbara Mus. Nat. Hist., Santa Barbara, California. 369 p.
- Jirkov, I. A. and N. Y. Paraketsova. 1996. Review of the species of *Micronephthys* (Polychaeta, Nephtyidae) from the White Sea. *Zool. Zh.* 75: 831–840. [in Russian].
- Kitamori, R. 1960. Two new species of cirratulid and Nephthyidae (Annelida: Polychaeta). *Bull. Jap. Soc. Scient. Fish.* 22: 1082–1085.
- Lee, J.-H. and J.-G. Jae. 1983. Polychaetous annelids from the Yellow Sea. I. Family Nephtyidae. *Bull. KORDI* 5: 19–27.
- Lovell, L. L. 1997. A review of six species of *Nephtys* (Cuvier, 1817) (Nephtyidae: Polychaeta) described from the eastern Pacific. In D. J. Reish and P.-Y. Qian eds. *Proc. 5th Int'l. Polychaete Conference, Qingdao, China 1995*. *Bull. Mar. Sci.* 60: 350–363.
- Mackie, A. S. Y. and J. Gobin. 1993. A review of the genus *Johnstonia* Quatrefages, 1866 (Polychaeta, Maldanidae), with a description of a new species from Trinidad, West Indies. *Zoologica Scr.* 22: 229–241.
- _____. and P. G. Oliver. 1996. Marine macrofauna: polychaetes, molluscs and crustaceans. Pages 263–284 in G. S. Hall, ed. *Methods for the examination of organismal diversity in soils and sediments*. CAB International, Wallingford. 307 p.
- _____. and P. F. Kingston. 1993. The macrobenthic infauna of Hoi Ha Wan and Tolo Channel. Pages 657–674 in B. Morton, ed. *Proc. 1st Int'l. Conf. Marine Biology of Hong Kong and the South China Sea, Hong Kong 28 October–3 November 1990*. Hong Kong Univ. Press, Hong Kong. 734 p.
- Noyes, G. S. 1980. The biology of *Aglaophamus neotenus* (Polychaeta: Nephtyidae), a new species from Maine. *Biol. Bull.* 158: 103–117.
- Ohwada, T. 1985a. Prostomium morphology as a criterion for the identification of nephtyid polychaetes (Annelida: Phyllodocida), with reference to the taxonomic status of *Aglaophamus neotenus*. *Publs Seto Mar. Biol. Lab.* 30: 55–60.
- _____. 1985b. Redescription of the nephtyid polychaete *Aglaophamus minusculus* Hartman, 1965. *Proc. Biol. Soc. Wash.* 98: 604–610.

- Pettibone, M. H. 1963. Marine polychaete worms of the New England region. 1. Aphroditidae through Trochochaetidae. Bull. U.S. Nat'l. Mus. 227: 1–356.
- Rainer, S. F. and U. L. Kaly. 1988. Nephtyidae (Polychaeta: Phyllodocida) of Australia: new species from the North West Shelf, and a key to Australian species. J. Nat. Hist. 22: 658–703.
- San Martin, G. 1982. Una nueva especie de Nephtyidae (Poliquetos: Errantes) del Mediterraneo: *Micronephtys maryae* n.sp. Cah. Biol. Mar. 23: 427–434.
- Sundberg, P., C. Erséus and A. S. Y. Mackie. 1992. Distribution of annelids and nemerteans along three transects at Hoi Ha Beach. Pages 865–881 in B. Morton, ed. Proc. 4th Int'l. Mar. Bio. Workshop: The marine flora and fauna of Hong Kong and southern China, Hong Kong, 11–29 April 1989. Hong Kong Univ. Press, Hong Kong. 921 p.
- Taylor, J. L. 1984. Family Nephtyidae Grube, 1850. Pages 35.1–35.20 in J. M. Uebelacker and P. G. Johnson, eds. Taxonomic guide to the polychaetes of the northern Gulf of Mexico, V. Barry A. Vittor and Associates, Mobile, Alabama. 149 p.
- Théel, H. 1879. Les annélides polychètes des mers de la Nouvelle-Zemble. K. Svenska VetenskAkad. Handl. 16: 1–75, pl. I–IV.
- Wesenberg-Lund, E. 1949. Polychaetes of the Iranian Gulf. Dan. Scient. Invest. Iran 4: 247–400.

ADDRESS: *Department of Biodiversity and Systematic Biology, National Museum of Wales, Cathays Park, Cardiff CF10 3NP, Wales, U.K. E-mail: <Andrew.Mackie@nmgw.ac.uk>.*